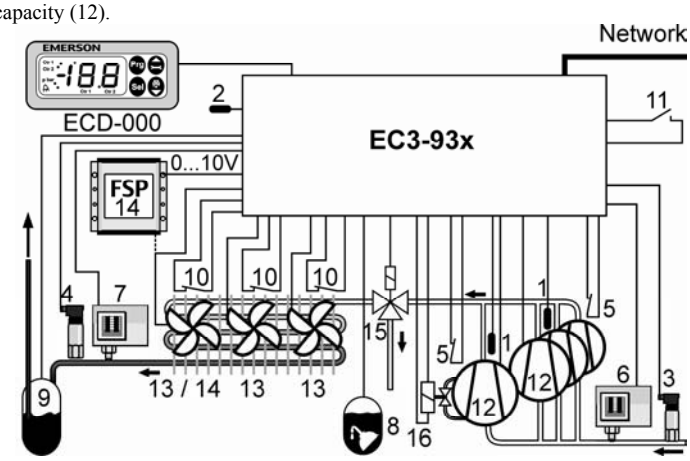
EC3-931 Rack and Condenser Controller and ECD-000 Display Unit

Operating Instructions

GB

Note: This document contains short form instructions for experienced users. Use last column in List of Parameters to document your individual settlings. More detailed information can be found in the User Manual.

The **EC3-931** is a digital controller for racks and condensers in commercial refrigeration applications. The rack may consist of up to 4 compressors one of which may be a Copeland Digital Scroll or a variable speed compressor using the 0-10V analogue output to a frequency inverter. The condenser control may consist of up to 3 cycled fans plus one speed controlled single phase fan through the onboard TRIAC. For the rack controller, the control target is to maintain the suction pressure (3) at a defined value by varying the available compressor capacity (12).



The control target for the condenser controller is to maintain the condensing pressure (4) at a defined value by varying the available fans (13). For the measurement of the suction pressure and the condensing pressure, two PT pressure sensors with a 4 – 20 mA interface can be connected to the controller. The controller has four relays outputs to command the compressors (12), the fans (13) and the heat recovery solenoid (15). Eight digital inputs for 24V AC/DC or 230V AC and four digital inputs for 24V AC/DC are available, four for compressor serial alarm (5), three for the fan serial alarm (10), one for low pressure alarm (6), one for high pressure alarm (7), one for oil level alarm (8), one for refrigerant level alarm (9) and one for heat recovery demand (11). To control the discharge end temperature of compressors, four temperature inputs (1) are available. If a Digital Scroll is installed (16) it should be connected to relay "comp 1" and the corresponding temp. sensor to "disch 1". Alternatively, two analogue outputs 0 to 10 V are available to control the first compressor or the first fan are inverter driven (14).

The optional **ECD-000** Display Unit can be connected to the EC3-931 for local display of control parameters and for controller setup without the use of a PC. Because the EC3-931 is fully functional without display unit the ECD-000 may be removed at any time.

⚠ Safety instructions:

- **Read installation instructions thoroughly. Failure to comply can result in device failure, system damage or personal injury.**
- **The product is intended for use by persons having the appropriate knowledge and skills.**
- **Ensure electrical ratings per technical data are not exceeded.**
- **Disconnect all voltages from system before installation.**
- **Keep temperatures within nominal limits.**
- **Comply with local electrical regulations when wiring**

Technical Data

EC3 Series Controller

Power supply	24VAC ±10%; 0.5A; 50/60Hz; Class II 6.3mm spade earth connector
Power consumption	20VA max.
Communication	LON, FTT10 free topology
Plug-in connector size	Removable screw terminals wire size 0.14 … 1.5 mm²
Temperature storage operating	-20 … +65°C 0 … +60°C
Humidity	0…80% r.h. non condensing
Protection class	IP20
Pressure transmitter inputs	24VDC, 4...20mA
Temp. ambient (2) Temp 1: for Digital Scroll (based on settings) Temp. 1, 2, 3&4 input discharge	NTC 10 kΩ @ 25°C, -50 … +50°C NTC 86 kΩ @ 25°C -40 to +180°C applies if C4= 2 & F5= 2 1 MΩ @ 25°C, +50 … +150°C
Digital Inputs	24VAC/DC or 230VAC
Compressor output relays (4x) + General alarm output Digital scroll output	Inductive (AC15) 250V/2A Resistive (AC1) 250V/8A Semi-conductor switch, 24 … 230 VAC

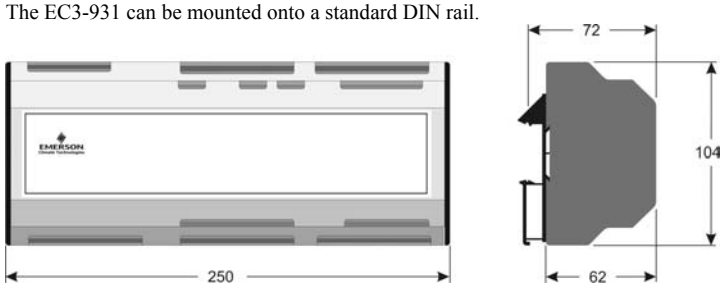
ECD-000 Display Unit

Power Supply	from EC3 via connecting cable
Display	2½-digit red LED with decimal point reversible between °C and °F
LED indicators	Controller 1, Controller 2, p bar, Alarm, IR status
Temp & Humidity	Identical to EC3 specifications above
Protection class	IP65 (front protection with gasket)
Connecting cable	ECC-N10 (1m), ECC-N30 (3m), ECC-N50 (5m) or CAT5 cable with RJ45 connectors

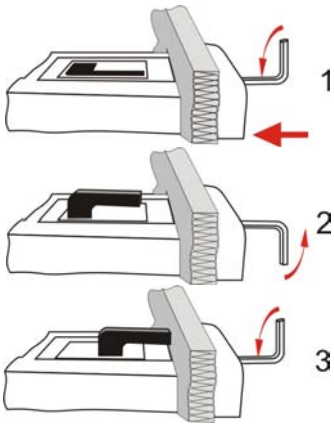
Marking EC3/ECD: AB28

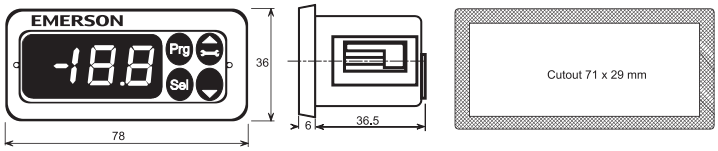
Mounting

The EC3-931 can be mounted onto a standard DIN rail.



The ECD-000 can be mounted in panels with a 71x29 mm cutout. See dimensional drawing below for space requirements including rear connectors.
Push controller into panel cutout. (1)
Make sure that mounting lugs are flush with outside of controller housing
Insert allen key into front panel holes and turn clockwise. Mounting lugs will turn and gradually move towards panel (2)
Turn allen key until mounting lug barely touches panel. Then move other mounting lug to the same position (3)
Tighten both sides very carefully until display is secured. Do not over tighten as mounting lugs will break easily.





Electrical Installation

Refer to the electrical wiring diagram (below) for electrical connections. A copy of this diagram is labeled on the controller. Use connection wires/cables suitable for 90°C operation (EN 60730-1). Ground the metal housing with a 6.3mm spade connector.

Important: Keep controller and sensor wiring well separated from mains wiring. Minimum recommended distance 30mm..

Warning: Use a class II category transformer for 24VAC power supply (EN 60742). Do not ground the 24VAC lines. We recommend to use one transformer per EC3 controller and to use separate transformers for 3rd party controllers, to avoid possible interference or grounding problems in the power supply. Connecting any EC3 inputs to mains voltage will permanently damage the EC3.

Setup and Parameter Modification Using the Keypad of the ECD-000

For convenience, an infrared receiver for the optional **IR remote control unit** is build-in, enabling quick and easy modification of the system parameters when a computer interface is not available.

Alternatively, the parameters can be accessed via the 4-button keypad. The configuration parameters are protected by a numerical password. The default password is "12". To select the parameter configuration:

- Press the **PRG** button for more than 5 seconds
  A flashing "0" is displayed
- Press ▲ or ▼ until "12" is displayed; (password)
- Press **SEL** to confirm password
  The first modifiable parameter code is displayed (/1).

To modify parameters see Parameters modification below.

Parameter Modification: Procedure

- Press ▲ or ▼ to show the code of the parameter that has to be changed;
- Press **SEL** to display the selected parameter value;
- Press ▲ or ▼ to increase or decrease the value;
- Press **SEL** to temporarily confirm the new value and display its code;
- Repeat the procedure from the beginning "*press* ▲ or ▼ *to show...*"

To exit and save the new settings:

- Press **PRG** to confirm the new values and exit the parameters modification procedure.

To exit without modifying any parameter:

- Do not press any button for at least 60 seconds (TIME OUT).
- Press "**ESC**" on IR remote control.

Neuron Id / Service Pin:

The service pin is available on ECD display and on the controller. It is only needed, when using controller in a LON network.

Display:

Press the ▲ button for app. 1 second to send the Neuron ID. An LED (Service) in the left upper corner will indicate the transmission of the Neuron ID.

Controller:

There is a small hole left of the network connector. Use a small pen or screwdriver to press the switch behind the hole. An LED close to the switch will light to indicate the transmission of the Neuron ID.

Load Default Parameters:

Use a small pen or screwdriver to press the service pin switch on the controller and switch on the power supply on. The EC3-931 will be reset to its default settings.

Special Functions:

The Clear Alarm function has been replaced by the Special Functions mode. The Special Functions can be activated by:

- Press ▲ and ▼ together for more than 5 seconds.
  A flashing 0 is displayed.
- Press ▲ or ▼ until the password is displayed (default = 12). If password was changed, select the new password.
- Press **SEL** to confirm password
  A 0 is displayed and the Special Function mode is activated.
- Press ▲ or ▼ to select the function. The number of special functions is dynamic and controller dependent. See list below.
- Press **SEL** to activate the function without leaving the special function mode.
- Press **PRG** to activate the function and leave the special function mode.

Most of the Special Functions work in a toggle mode, the first call activates the function, and the second call deactivates the function.

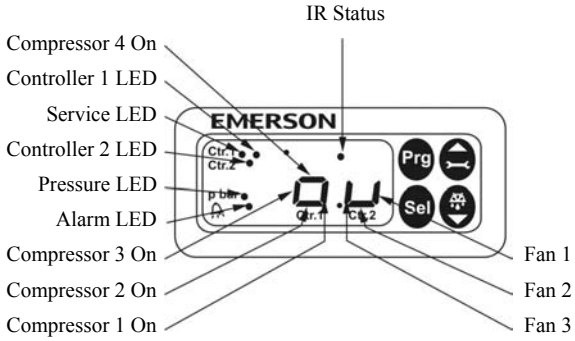
The indication of the function can only be displayed after exiting the special function mode.

- 0: Display test function
- 1: Resets all parameters to the factory default setting. The controller will indicate "oF" during the reset.

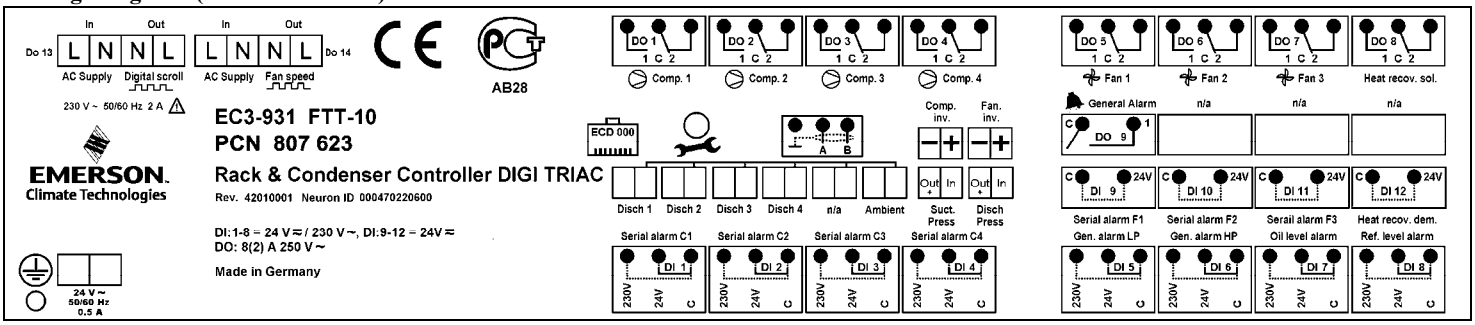
Display of Data:

The data to be permanently shown on the display can be selected by the user (parameter /1). In case of an alarm, the alarm code is displayed alternately with the selected data. The user can inhibit the alarm code.

It is possible to temporarily display these values. This is a useful feature when initially setting-up the system without the aid of the LON interface. Press the **SEL** button to scroll through all possible displayable data. The display will show for one second the numerical identifier of the data (see /1 parameter) and then the selected data. After two minutes the display will return to the by parameter /1 selected data. This action is only valid when parameter H2 = 3



Wiring Diagram (controller label)



List of Parameters

/	DISPLAY PARAMETERS	Min	Max	Unit	Def.	Custom
/1	Value to show 0 = Compressors and fans states (controller 1 and controller 2) 1 = Suction pressure (bar) 2 = Suction temperature (°C) calculated from suction pressure 3 = Condensing pressure (bar) 4 = Condensing temperature (°C) calculated from discharge pressure 5 = Digital Scroll capacity (%) 6 = Variable fan speed capacity %	0	5	-	0	

Controller 1 (Rack Controller)

P	SET-POINT PARAMETERS					
P0	Suction pressure set point	-1	50	bar	3.0	
P1	Suction band	0	50	bar	2.0	
P3	Fast recovery from low pressure	-9.9	50	bar	-9.9	
P4	Suction shift (0=disabled, 1=enabled)	0	1	-	0	
P5	Suction shift max	0	3.0	bar	3.0	
P8	High discharge pressure recovery	-9.9	50	bar	50	
P9	Discharge recovery step	0	5.0	bar	1.0	

t	TIME PARAMETERS					
t0	Integration time	30	99	10 sec*	60	
t1	Time delay before adding capacity	0	99	10 sec*	6	
t2	Time delay before removing capacity	0	99	10 sec*	0.2	
t3	Compressor min on time	0	99	10 sec*	6	
t4	Compressor min off time	0	99	10 sec*	6	
t5	Maximum compressor switching (0=number of switching unrestricted)	0	199	1/hr	0	

A	ALARM-PARAMETERS					
A0	Alarm delay LP	0	99	10 sec*	0	
A1	Alarm delay HP	0	99	10 sec*	0	
A2	Suction alarm min. limit	-1.0	50	bar	1.0	
A3	Suction alarm max. limit	-1.0	50	bar	6.0	
A4	Alarm delay suction min. limit	0	99	10 sec*	0	
A5	Alarm delay suction max. limit	0	99	10 sec*	0	
A6	Maximum discharge temperature	50	150	°C	130	
A7	Maximum discharge temperaturedelay	0	99	10 sec*	3	
A8	Alarm delay serial alarm comp.	0	99	10 sec*	0	
A9	Compressor service interval	0	99	10 000 hr**	0	

u	STEP ENABLE PARAMETERS					
u0	Compressor service interval reset 0 = do nothing 3 = reset operating time compr. 3 1 = reset operating time compr. 1 4 = reset operating time compr. 4 2 = reset operating time compr. 2 5 = reset op. time all compressors	0	5	-	0	
u1	Compressor 1 enable (0=disable, 1=enable)	0	1	flag	1	
u2	Compressor 2 enable (- " -)	0	1	flag	1	
u3	Compressor 3 enable (- " -)	0	1	flag	1	
u4	Compressor 4 enable (- " -)	0	1	flag	1	

c	APPLICATION PARAMETERS					
c1	Number of compressors	1	4	-	4	
c3	Compr. control mode (0 = P mode, 1 = PI mode, **2 = dead band mode** 3 = binary mode)	0	3	-	**2**	
c4	Compressor 1 control mode 0 = in standard control loop 1 = act as base load compressor **2 = act as modulating capacity**; function defined by parameter F5	0	2	-	2	
c5	Compressor rotation 0 = FILO logic (First In, Last Out) 1 = FIFO logic (First In, First Out)	0	1	flag	1	
c6	Sensor fail (number of compressors in case of sensor failure)	0	4	-	0	
h0	Discharge pressure sensor 0 = not available; 1 = available	0	1	flag	1	

r	SENSOR PARAMETERS					
r0	Suction sensor 0%	-1.0	50	bar	-0.8	
r1	Suction sensor 100%	-1.0	50	bar	7	
r2	Suction sensor offset	-1.0	1.0	bar	0.0	
r3	Refrigerant 0 = R 22 2 = R 507 4 = R 407C 6 = R 124 1 = R 134a 3 = R 404A 5 = R 410A 7 = R 744	0	7	-	3	

* Resolution = 10 sec, on the local display. Example a value 2 means 20 sec.

** Resolution = 10,000 hrs. on the local display. Example a value 2 means 2.000 hours.

F	MODULATING PARAMETERS	Min	Max	Unit	Def.	Custom
F2	Minimum output value	10	100	%	10	
F3	Maximum output value	10	100	%	100	
F5	Analogue output mode for Comp. 1 0 or 1= 0 - 10V ; 2 = PWM (digital)	0	2	-	2	
F3	PWM rate (Digital Scroll)	10	20	sec	10	

Controller 2 (Condenser Controller)

P	SET-POINT PARAMETERS					
P0	Condensing pressure set point	-1	50	bar	14.0	
P1	Cond. pressure band	0	50	bar	4.0	
P2	Condensing pressure set point 2	-1	50	bar	14.0	
P3	Condensing recovery min	-9.9	50	bar	-9.9	
P4	Condensing shift (0 = off, 1 = on)	0	1	-	0	
P5	Condensing shift max	0.0	3.0	bar	3.0	
P6	Condensing shift temp min	-50	50	°C	30°C	
P7	Condensing shift temp max	-50	50	°C	15°C	
P8	Condensing recovery max	-9.9	50	bar	50	

t	TIME PARAMETERS					
t0	Integration time	30	99	10 sec*	60	
t1	Time delay before adding capacity	0	99	10 sec*	3	
t2	Time delay before removing capacity	0	99	10 sec*	3	

A	ALARM-PARAMETERS					
A1	Alarm delay HP	0	99	10 sec*	0	
A2	Condensing alarm limit min	-1.0	50	bar	10	
A3	Condensing alarm limit max	-1.0	50	bar	27	
A4	Alarm delay condensing limit min	0	99	10 sec*	0	
A5	Alarm delay condensing limit max	0	99	10 sec*	0	
A8	Alarm delay serial alarm fan	0	99	10 sec*	0	
A9	Service interval	0	99	1 000 hr**	0	

u	STEP ENABLE PARAMETERS					
u0	Fan service interval reset 0 = do nothing 3 = reset operating time fan 3 1 = reset operating time fan 1 4 = reset op. time all fans 2 = reset operating time fan 2	0	4	-	0	
u1	Fan 1 enable (0=disable, 1=enable)	0	1	flag	1	
u2	Fan 2 enable (0=disable, 1=enable)	0	1	flag	1	
u3	Fan 3 enable (0=disable, 1=enable)	0	1	flag	1	

c	APPLICATION PARAMETERS					
c1	Number of fans	1	3	-	3	
c3	Control mode (0 = P mode, 1 = PI mode, 2 = dead band mode)	0	2	-	2	
c4	First fan control mode 0 = in standard control loop, 2 = act as modulating capacity (0…10V 1 = act as base load fan, for inverter command or TRIAC output)	0	2	-	0	
c5	Fan rotation 0 = FILO logic (First In, Last Out) 1 = FIFO logic (First In, First Out)	0	1	flag	0	
c6	Sensor fail (nr. of fans in case of sens fail)	0	4	-	0	

r	SENSOR PARAMETERS					
r0	Condensing sensor 0%	-1.0	50	bar	0.0	
r1	Condensing sensor 100%	-1.0	50	bar	30	
r2	Condensing sensor offset	-1.0	1.0	bar	0.0	

F	MODULATING PARAMETERS					
F2	Minimum output value	0	100	%	0	
F3	Maximum output value	0	100	%	100	
F4	Fan 1 at min: (0=off; 1 =min speed)	0	1	flag	0	
F7	Output mode for modulating control: 0 = 0 – 10V analogue output; 1 = Phase cutting with Triac	0	1	flag	0	

H	OTHER PARAMETERS					
H2	ECD Display access 0 = all disabled (Caution, access to controller only via TCP/IP network possible) 1 = Keyboard enabled 2 = IR remote control enabled 3 = Keyboard and IR remote control enabled	0	3	-	3	
H3	IR access code	0	199	-	0	
H5	Password	0	199	-	12	

Alarm Codes

HP **General alarm HP**
Controller 1 + 2: High pressure signal from digital input

LP **General alarm LP**
Controller 1: Low pressure signal from digital input

hP **High pressure alarm**
Controller 1 suction pressure; Controller 2 condensing pressure to high

lP **Low pressure alarm**
Controller 1 suction pressure; Controller 2 condensing pressure to low

EP **Sensor failure**
Controller 1 suction pressure; Controller 2 condensing press. sensor fail

Ed **Sensor failure condenser**
Controller 1: Discharge pressure sensor failure

Fr **Fast recovery suction low**
Controller 1: Fast recovery from low suction pressure
Controller 2: Fast recovery from low condensing pressure

hr **Fast recovery from high pressure**
Controller 1: High suction pressure recovery
Controller 2: High discharge pressure recovery

d1 **Discharge temperature alarm 1**
Discharge end temperature from compressor 1 is too high

d2 **Discharge temperature alarm 2**
Discharge end temperature from compressor 2 is too high

d3 **Discharge temperature alarm 3**
Discharge end temperature from compressor 3 is too high

d4 **Discharge temperature alarm 4**
Discharge end temperature from compressor 4 is too high

E1 **Serial alarm E1**
Controller 1: Digital input from compressor 1 alarm (safety chain)
Controller 2: Digital input from fan 1 alarm (safety chain)

E2 **Serial alarm E2**
Controller 1: Digital input from compressor 2 alarm (safety chain)
Controller 2: Digital input from fan 2 alarm (safety chain)

E3 **Serial alarm E3**
Controller 1: Digital input from compressor 3 alarm (safety chain)
Controller 2: Digital input from fan 3 alarm (safety chain)

E4 **Serial alarm E4**
Controller 1: Digital input from compressor 4 alarm (safety chain)

n1 **Service alarm compressor 1 / fan 1**
Controller 1: Compressor 1 operating time higher than run limit
Controller 2: Fan 1 operating time higher than run limit

n2 **Service alarm compressor 2 / fan 2**
Controller 1: Compressor 2 operating time higher than run limit
Controller 2: Fan 2 operating time higher than run limit

n3 **Service alarm compressor 3 / fan 3**
Controller 1: Compressor 3 operating time higher than run limit
Controller 2: Fan 3 operating time higher than run limit

n4 **Service alarm compressor 4**
Controller 1: Compressor 4 operating time higher than run limit

oL **Oil receiver level alarm**
Controller 1: Oil level detection from digital input

rL **Refrigerant level alarm**
Controller 1: Refrigerant level detection from digital input

Er **Data error - out of range**
Data send to the display is out of range

Messages

--- **No data**
The display will show an "---" at node start up, when no data is send to the display or when the display is disabled.

In **Configuration data initialization**
The display will show an "In" when the configuration data are initialized with the factory default values.

Id **Wink request received**
The display will show a flashing "Id" when the wink request was received. The node will receive the flashing "Id" will be shown on the display until the service button will be pressed, or a 30 min delay timer will expire or a second wink request.

oF **Offline**
The node is offline: no application is running. This is the result of a network management command an will happen

- -- --- **Controller disabled, waiting for restart**
After a major change of the configuration parameter, the rack controller is disabled for 20 seconds. After this delay the controller restart automatically.

Visualising Data: LON Monitoring Server

The **EC3-931** has a LON communication interface enabling the controller to be directly connected to a Monitoring Server or a LON network. Refer to the Engineering documentation for detailed information. There are LON "plug-in's" available for quick visualization installation using the LON management software ANL220 or other commercial software packages.
The parameters will be visualised in real text together with the program code as defined in the parameter list below.
After the parameters have been modified, the complete list of settings can be saved to the memory of the computer and used later to upload into another controller. This can save a considerable amount of time when using multiple controllers and over a period of time, a library can be created containing the parameter lists for equipment for different applications.

Neuron ID / Service PIN:

The service pin is available on the ECD display. It is used to identify the controller in a LON network.

Press the button for app. 1 second to send the Neuron ID. The LED in the left upper corner will indicate the transmission of the Neuron ID.
The default settings may be modified remotely from the Monitoring Server via the LON network.
It is also possible to display live graphical data on the server or to log data containing the control temperature at defined intervals.

LonWorks® Interface

	FTT10
Structure	free topology
Termination	RC Network
Medium	Twisted pair, 2-wires
Connection	11, 12 Data - 13 free
Nodes/ Segment	64 Units
Transfer rate	78 kbits / s

Recommended cable types

Cable type	**Ø / AWG**	**R Ω / km**	**C nF / km**	**V % of c**	**FTT10 max. length in m**
Belden 85102	1,3 mm / 16	28	56	62	2700
Belden 8471	1,3 mm / 16	28	72	55	2700
Level IV 22 AWG	0,65 / 22	106	49	67	1400
JY (ST) 2x2x0,8	0,8 / 20,4	73	98	41	900
TIA 568A CAT 5	0,51 / 24	168	46	58	900

For more details see the Echelon LonMark documentation

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